Choice Models and Planning Models

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Background

- Unit of observation in most planning models used is an origination-destination-commodity triple.
- The annual output is the aggregation across shippers of individual decisions who may or may not be located on the river.
- If not located on a river, the shipments are shipped to a port.

Train and Wilson-Choices

- T/W model predicts the probability that a shipment will be sent by a given mode to a location given rate and time-in-transit for the shipment and the next best alternative.
- The probability estimate (prediction) can be interpreted as the share of shipments.
- This model can be implemented in Army planning models by assuming that the ODC triples are the result of shipper decisions (on and off the river). This assumption is already implied by Planning Models.

Train and Wilson-Choices

- Army planning models already specify the rates for the existing choice and the alternative choice. Taking these inputs as “representative” of all shipments within the ODC triple allow the T/W model to be implemented.

Data Requirements

- Much of the data already are collected and inputs into the planning models (e.g., rate, annual volume, locations)
- For data that do not currently exist:
  - They may be available (e.g., times-in-transit)
  - They may be collectable
  - They may be excluded

Variables

- Q = Annual volume for ODC triple by barge.
- $C_{b,}$ C_0= Full cost (rate from origin location, not the pool, to the terminal market) for barge and alternative
- $T_{b,}T_0$ = Total time in transit from original location, not the pool, to the terminal market for barge and alternative.
- R =A dummy for whether rail is used to access the barge port.
- Y =The typical or average number of years that the shipper has been at the location
- H = The fraction of transportation costs to value of the commodity shipped.

Implementation-Changes in rates/times

1. Calculate the share of shipments from the origin location to the destination location that go by barge under current conditions. This share is calculated from the model in Table 8 of the Train/Wilson report. The procedure for calculating the predicted share from the model is given in appendix 1. Label this share as S^1.
2. Calculate the share of shipments from the origin location to the destination location that go by barge under changed conditions. This calculation is the same as in step 1 except that the changed values of costs and times are used. Label this share S^2.
3. Calculate the share using barge under the changed conditions as a proportion of the share under the original conditions: S^2/S^1.

Implementation-Changes in rates/time

- 4. Calculate the percent reduction in annual volumes as a result of increased transit costs. This reduction is calculated from the model in Table 12, assuming that C_b^2 is greater than C_b^1. The steps for implementing this model are given in appendix 2. Label the predicted reduction M, where the percent is given in decimal form (e.g., a 10% reduction is expressed as 0.10.) Note that the volume under changed conditions is (1-M) times the volume under the original conditions.
- 5. Calculate the percent reduction in annual volumes as a result of increased transit times. This reduction is calculated from the model in Table 13, assuming that T_b^2 is greater than T_b^1. Label this reduction L, expressed in decimal form.
- Using the changes calculated in steps 3-5, calculate the predicted annual quantity for the ODC under the changed conditions as $Q^2=(S^2/S^1)*(1-M)*(1-L)*Q^1$.

Procedure for Implementing the Mode Share Model Table 8

- The model contains random coefficients for cost and time. Let w^r, $r=1,\ldots,R$ be R independent draws from a standard normal distribution, which will be used in constructing draws of the cost coefficient. Let u^r, $r=1,\ldots,R$, be R independent draws from a standard normal distribution, which will be used in constructing draws of the time coefficient.

The following steps are repeated for each *r*, for a total of *R* times.

1. Calculate the cost coefficient: Note that 1.1767 and 0.6329 are the mean and standard deviation, respectively, of a normal deviate that, when exponentiated, constitutes a lognormal deviate with a median of 3.2436 and mean of 3.9629 as given in Table 8.
2. Calculate the time coefficient: where *K* is a dummy that indicates that the commodity is not corn, wheat or soy. That is, *K=0* is the commodity is corn, wheat or soy and *K=1* otherwise. Note that this *K* is identified on the basis of the commodity in the ODC.
3. Calculate the representative utility of mode b: + 4.7048. Recall that R_b is a dummy that identifies whether rail is used as access to or egress from barge. The term 4.7048 always enters because barge is necessarily used for this mode. Note that this equation assumes that the origin and destination locations are the same for both modes, such that distance is the same and hence does not affect the relative representative utilities. (If a different destination location is specified for the overland mode than for the barge mode, then 3.3566 times the distance is added here for mode b and in step 4 for mode o.)

Steps-Continued

4. Calculate the representative utility of mode o.

$$V_o^r = b_c^r C_o + b_t^r T_o + 3.7036 R_o$$

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5. Calculate the share that is predicted for mode b under these draws of the cost and time coefficients:

$$S^r = \exp(V_b^r) / [\exp(V_b^r) + \exp(V_o^r)]$$

Steps-Continued

- The predicted share for mode b is then calculated as the average $S = (1/R)\sum_r S^r$ for all r:
- The share can be calculated at any values for the cost and time by each mode. The share under current conditions, labeled S_1 in the body of the memo, is calculated using C_b^1, T_b^1, C_o^1, and T_o^1. The share under changed conditions, labeled S_2, is calculated using C_b^2, T_b^2, C_o^2, and T_o^2.

Procedure for Implementing the Quantity Reduction Models of Tables 12 and 13

Let , *r=1,…,R,* be *R* independent draws from a standard normal distribution. We will provide intelligently drawn values, which can held in an input file and reused each time ORNIM is run. The reduction in annual volumes from increased transit costs is calculated from Table 12 as follows for each value of *r*:

1. Calculate

$$y^r = 0.8813*((C_b^2/C_b^1) - 1) + .7246*H^1 - .00171*Y + 0.0906 - .4933 + e$$

product value (calculated with the current costs) and Y is the years at current location. Note that the term 0.0906 always enters since all of the shipments under consideration are by barge.

2. Censor y^r from above at 1 and from below at 0:

$$\tilde{y}^r = \max(0, \min(1, y^r))$$

The predicted average reduction is the average of over all r: $M = (1/R) \sum_r \tilde{y}^r$

This M is the predicted reduction fom an increase in costs. The reduction due to a increase in transit times, L, is calculated analogously, using the coefficients from Table 13 instead of those from Table 12 and using the ratio instead of .